

# **Quantitative Validations of Subsurface Temperatures from the Assimilative HYCOM and NCOM**

**By**

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## **INTRODUCTION**

- Two global ocean models: HYCOM and NCOM

- brief description of each model
  - assimilation procedures

- Daily subsurface temperatures and SST

- validation against buoy temperatures in 2004
  - various statistical metrics and summary

We would like to answer the question,

which model performs better in simulating temperatures?

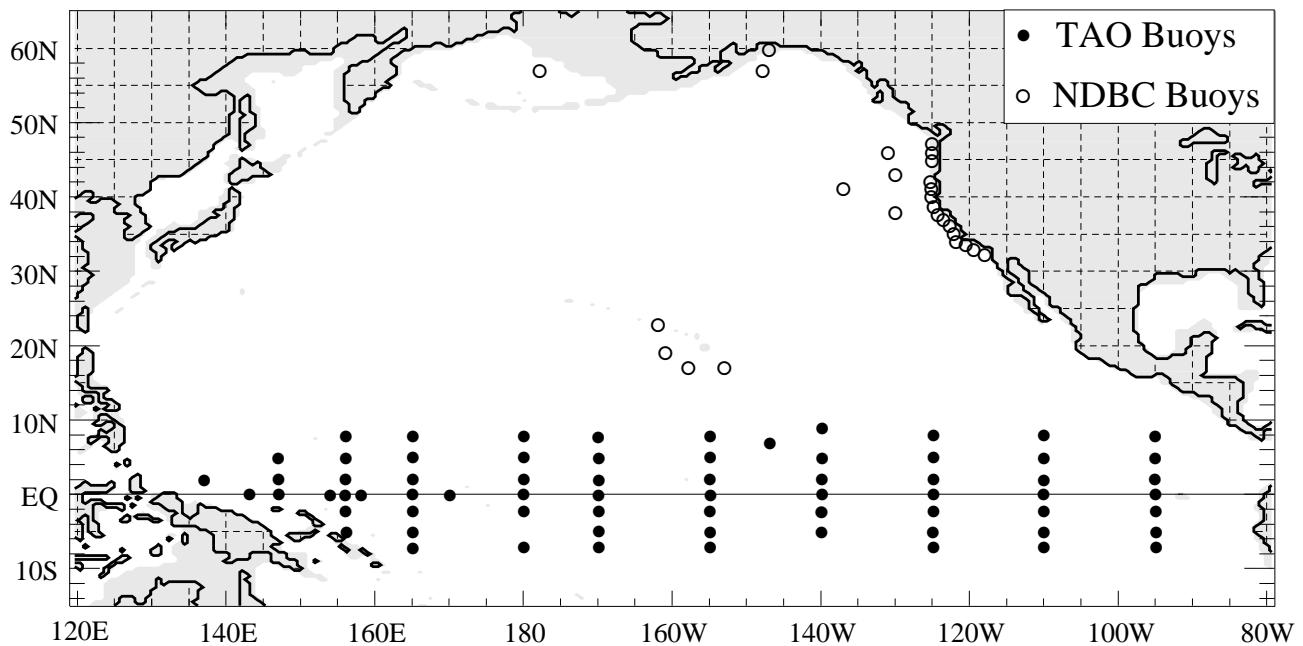
## **AN OVERVIEW OF THE MODELS**

	<b>NCOM</b>	<b>HYCOM</b>
<b>Grid resolution</b>	1/8°	1/12°
<b>Vertical layers</b>	40 level sigma-z	32 layer hybrid
<b>Initialization</b>	MODAS T/S	GDEM T/S
<b>Simulation</b>	Inter-annual	Inter-annual
<b>Mixed layer</b>	Mellor-Yamada	GISS
<b>Atm. forcing</b>	NOGAPS	NOGAPS
<b>River forcing</b>	NRL database	NRL database
<b>Turbidity</b>	Constant	SeaWiFS data
<b>Bulk formulae</b>	Sensible/latent heat	Sensible/latent heat
<b>Relaxation</b>	None except SSS	None except SSS

## **MAJOR FEATURES OF THE ASSIMILATION**

	<b>NCOM</b>	<b>HYCOM</b>
<b>Observation</b>	<b>SST and SSH</b>	<b>SST, SSH, profiles</b>
<b>Methodology</b>	<b>Nudging to MODAS</b>  <b>gridded 3D product</b>	<b>NCODA, MVOI</b>  <b>Cooper–Haines (1996)</b>
<b>Projection</b>	<b>Synthetic T and S,</b>  <b>1/32° NLOM SSH</b>  <b>1/8° MODAS SST</b>  <b>for profile calculation</b>	<b>Vertical projection,</b>  <b>incremental updating</b>  <b>of model variables</b>
<b>Time interval</b>	<b>daily assimilation</b>	<b>daily assimilation</b>

## SUBSURFACE TEMPERATURES FROM BUOYS



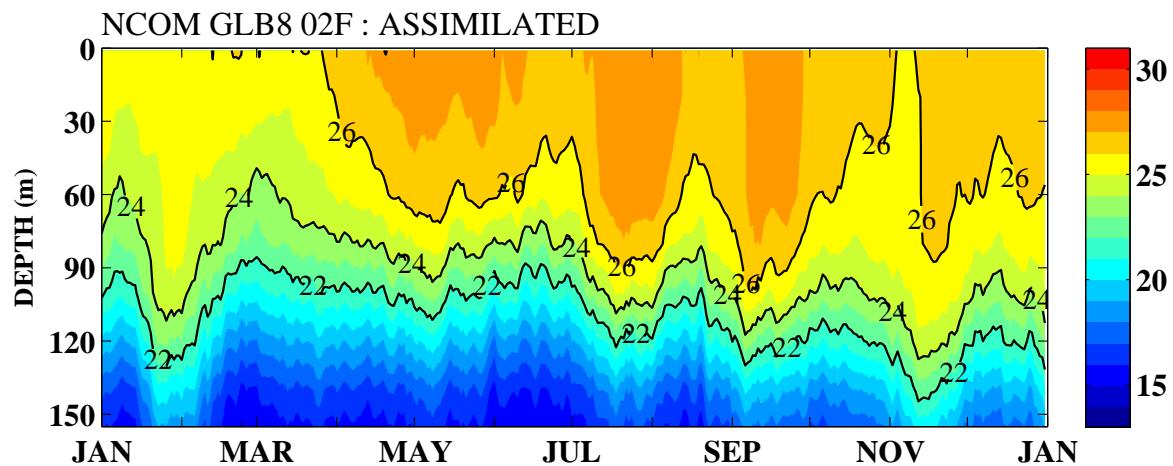
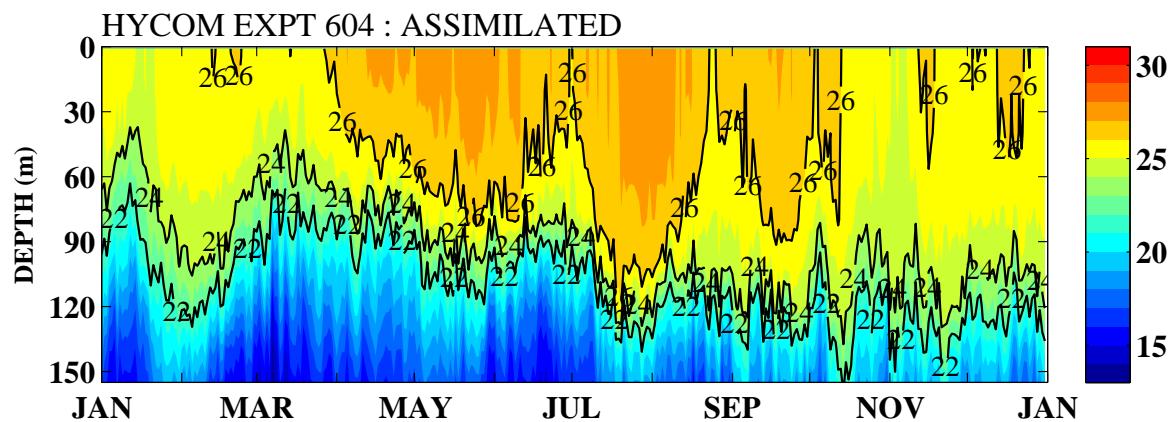
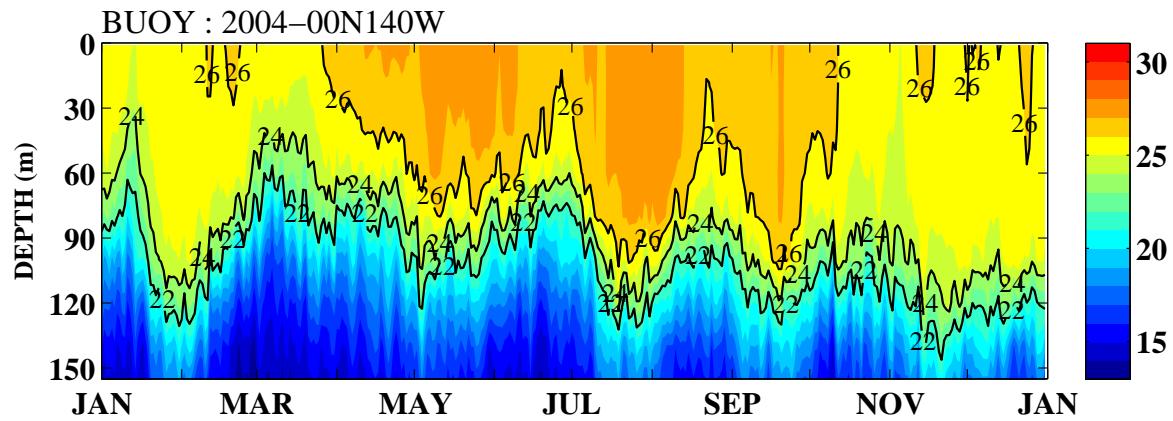
- Tropical Atmosphere–Ocean (TAO) array
- Pilot Research Moored Array in the Tropical Atlantic (PI-RATA)
- Two sets of buoys: temperatures at different depths
  - I: east of 155°W
    - 1, 20, 40, 60, 80, 100, 120, 140, 180, 300, 500 meters
  - II: west of 155°W, including 155°W
    - 1, 25, 50, 75, 100, 125, 150, 200, 250, 300, 500 meters

Note: NDBC buoys do NOT report subsurface temperatures

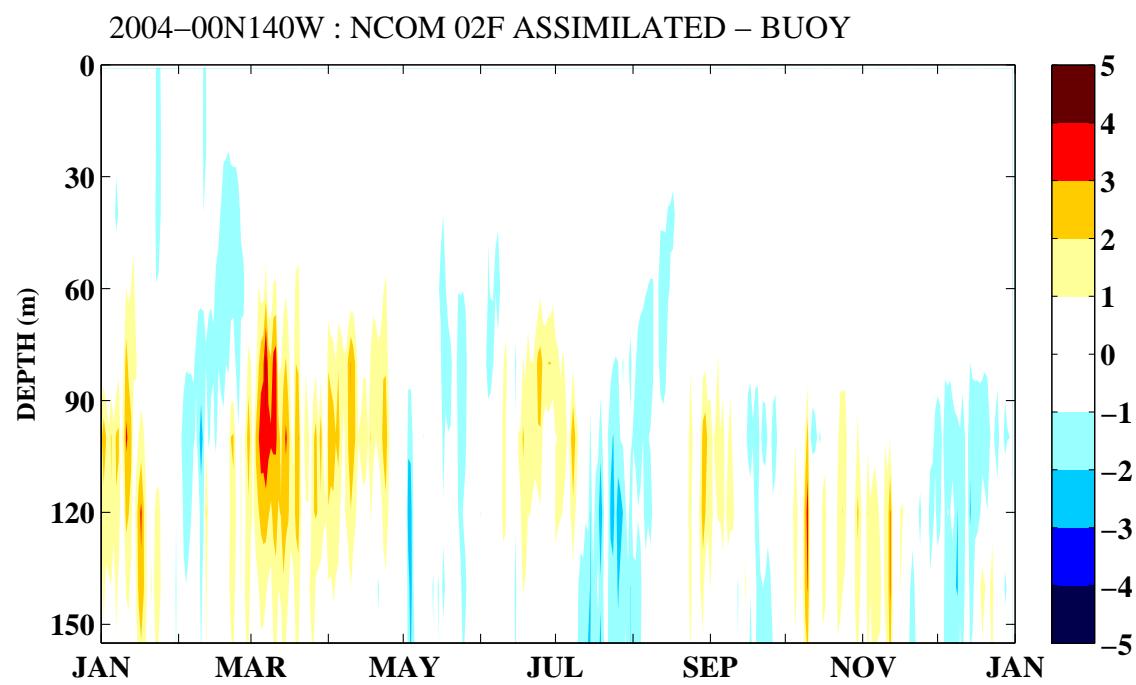
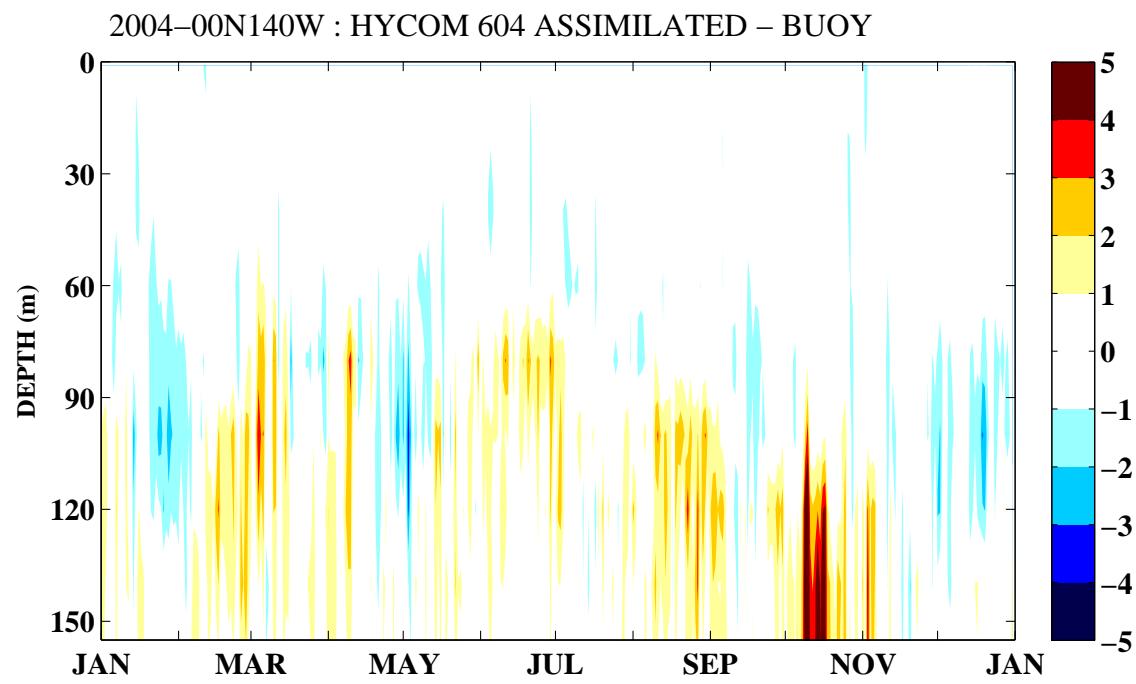
## **MODEL–DATA COMPARISONS**

- Validation procedure
  - yearlong subsurface temperatures at each depth
  - buoys which have a nearly complete yearlong time series
  - temperature voids at buoys filled if < 1 month
  - voids filled by linear interpolation
- Validation Statistics
  - calculate mean bias and RMS at each depth level
  - buoy vs NCOM and buoy vs HYCOM at each buoy
  - combining statistics using temperatures from all buoys

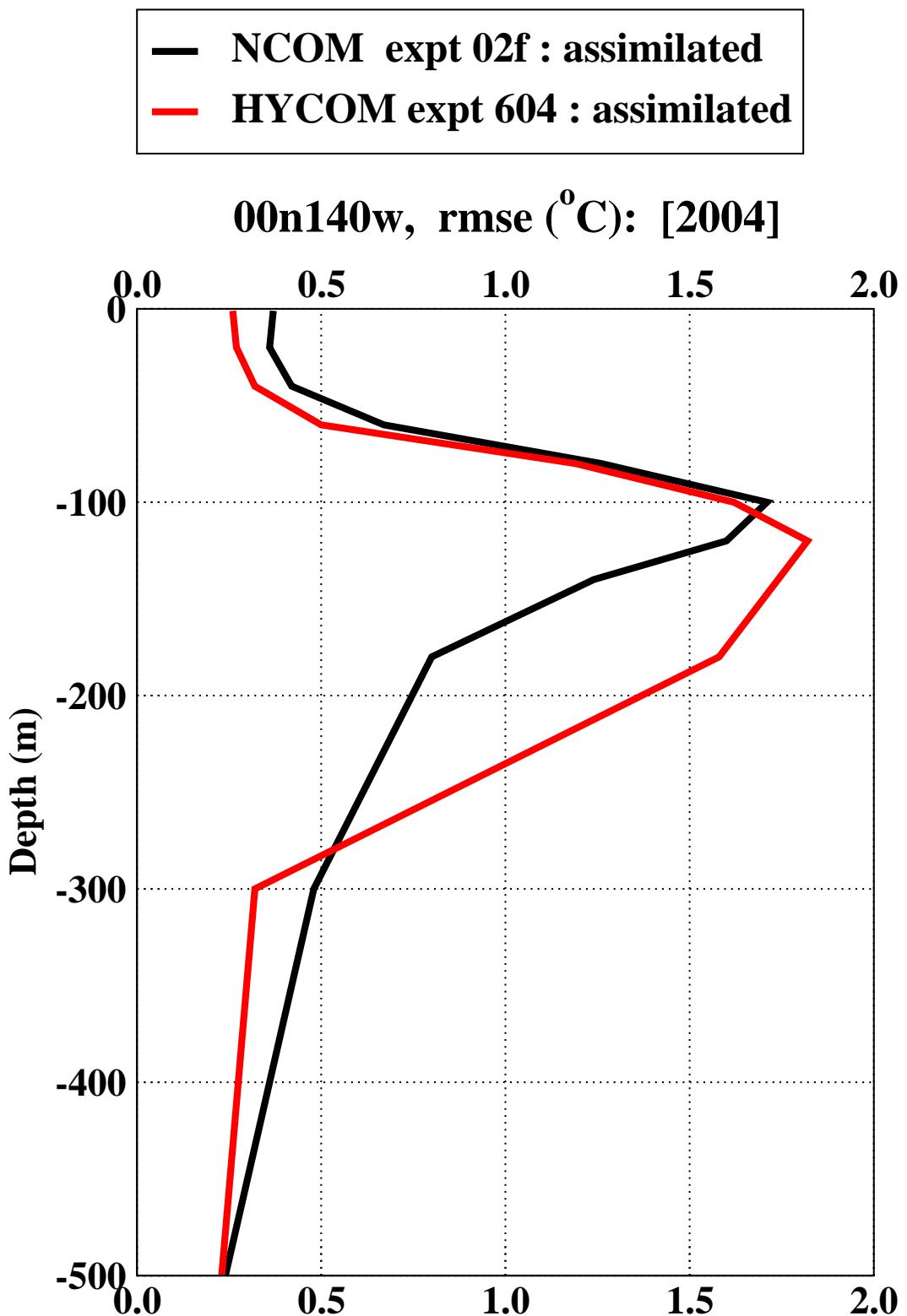
# SUBSURFACE TEMPERATURES AT (00°N, 140°W)



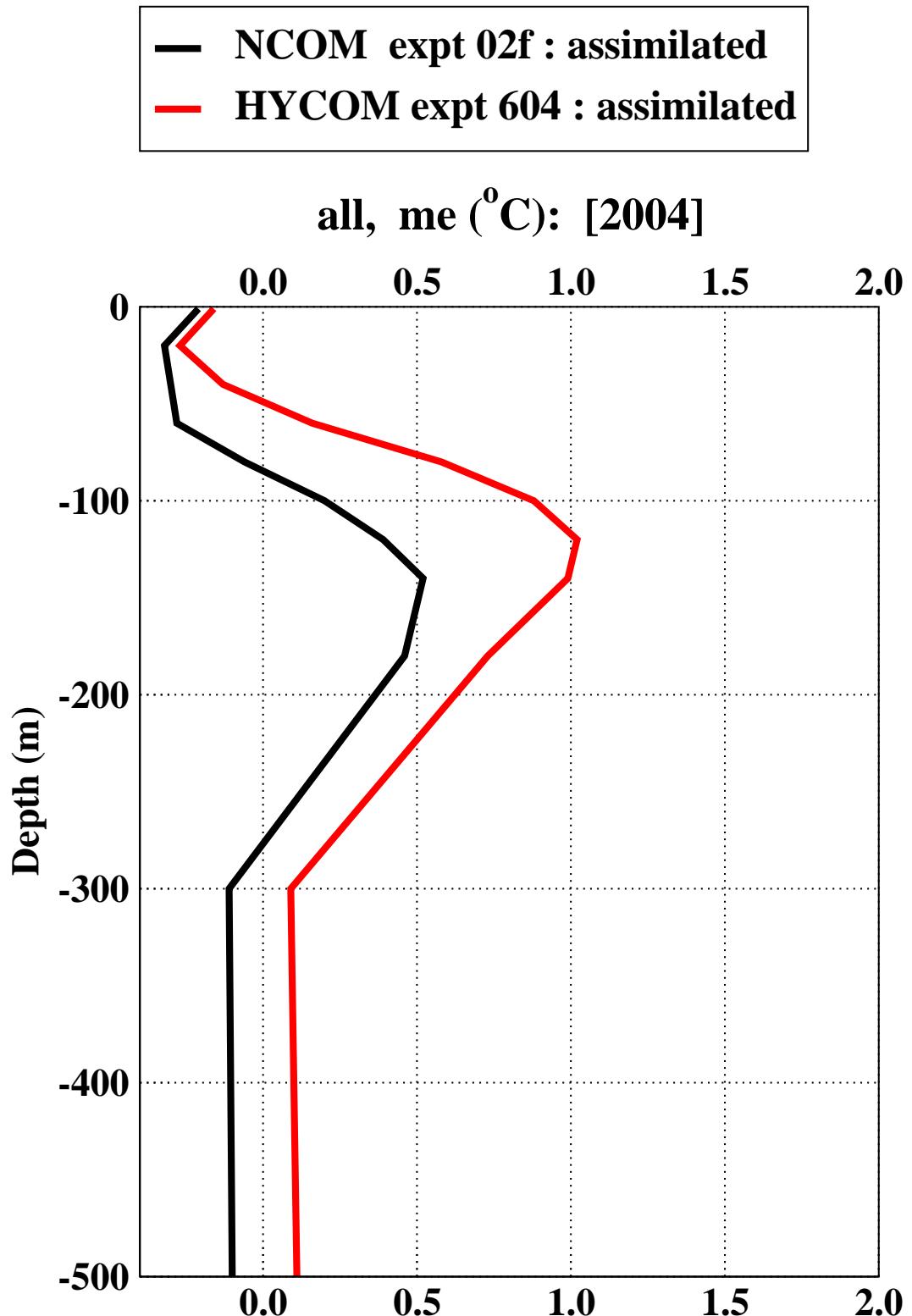
# TEMPERATURE DIFFERENCES AT (00°N, 140°W)



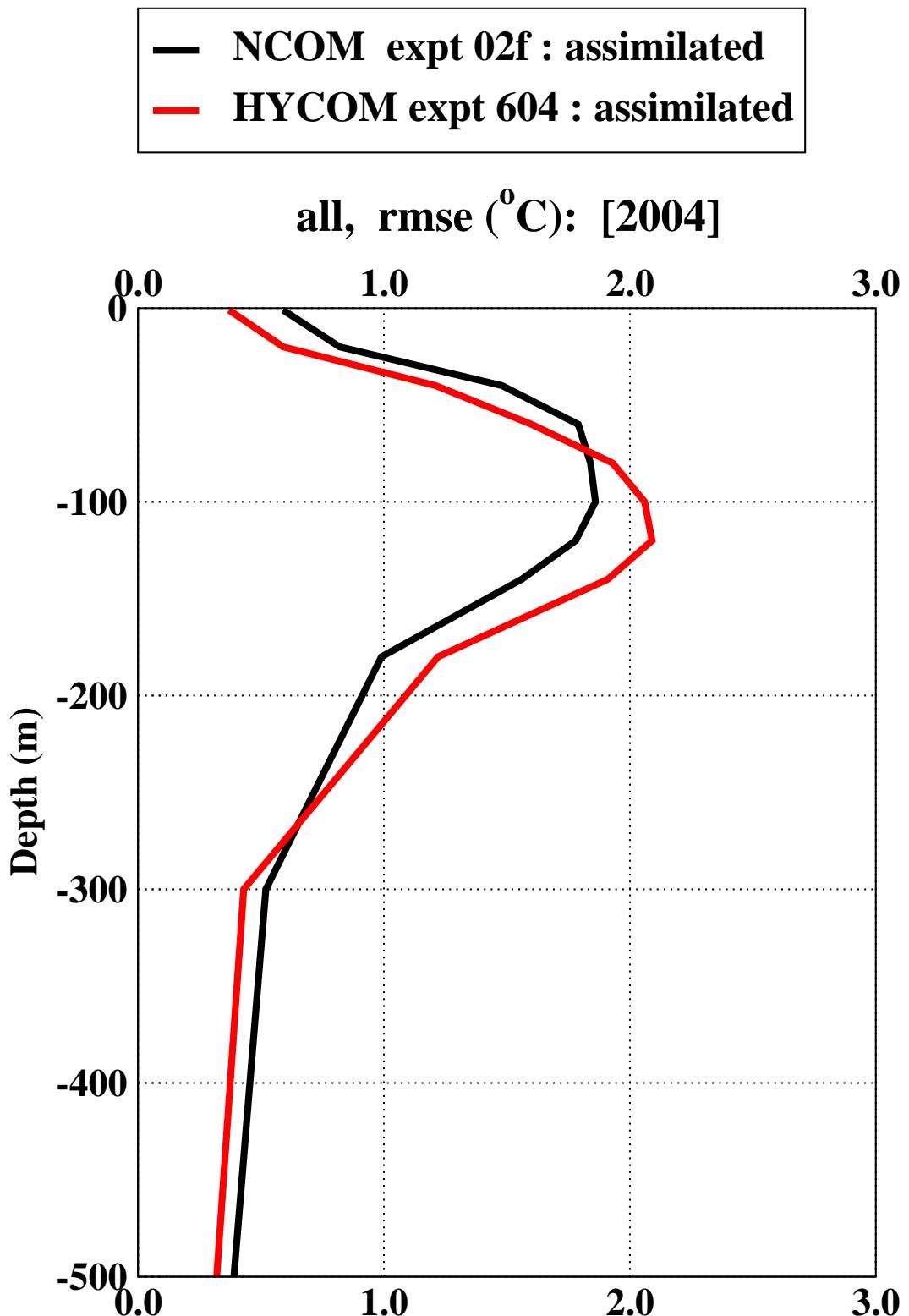
# RMS SST DIFFERENCE AT (00°N, 140°W)



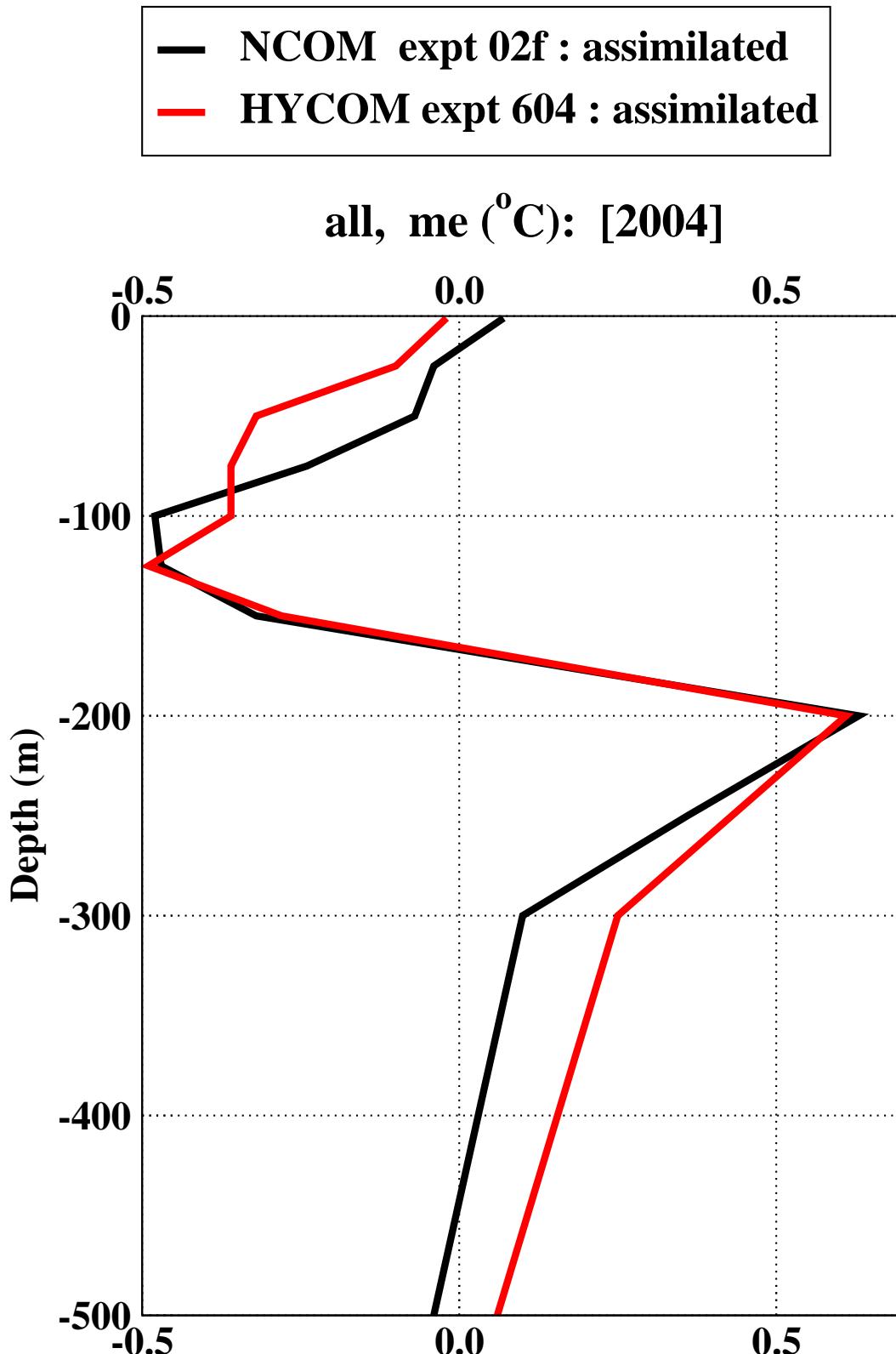
# SUMMARY STATISTICS FOR SET I BUOYS: BIAS



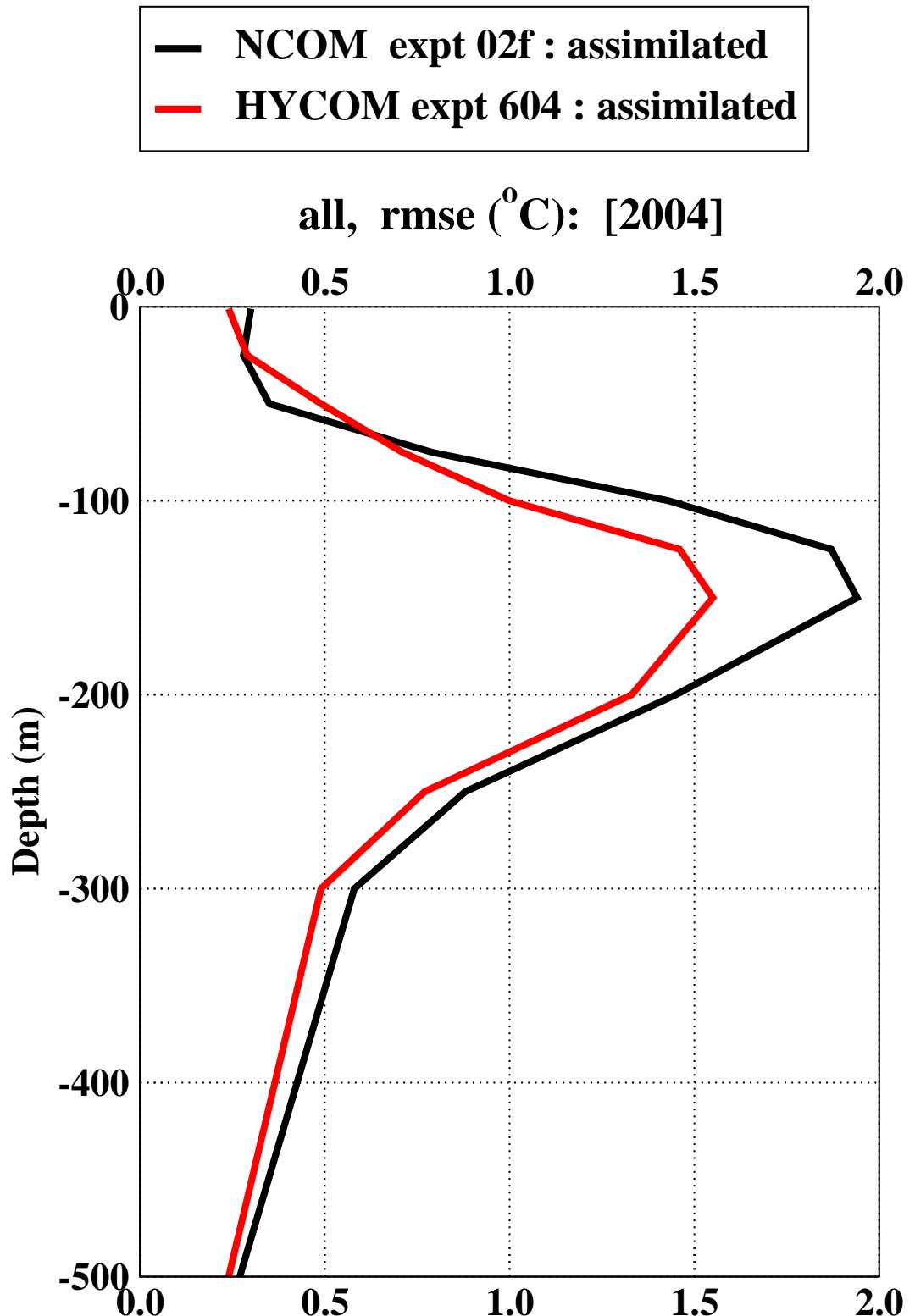
# SUMMARY STATISTICS FOR SET I BUOYS: RMS



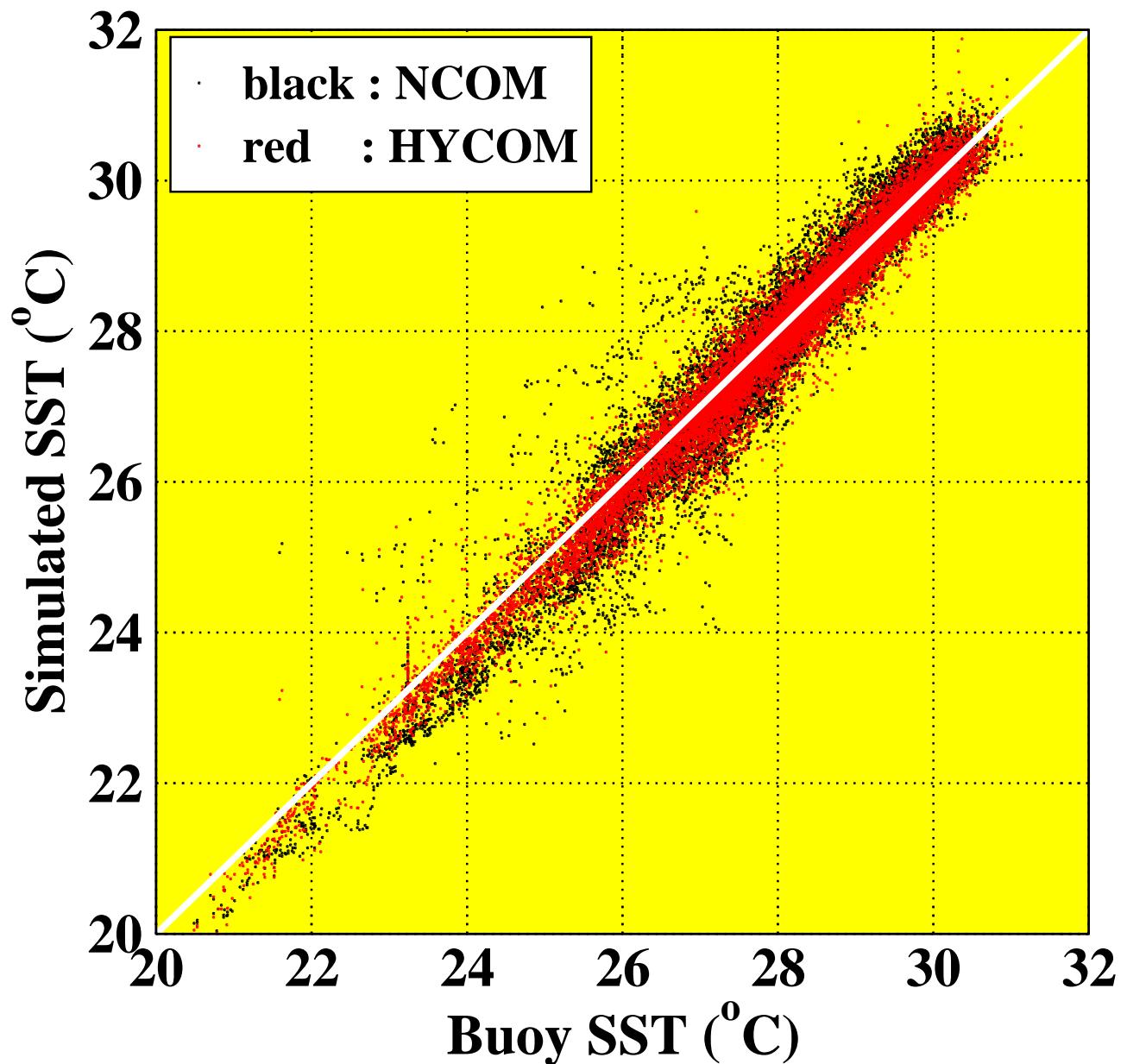
# SUMMARY STATISTICS FOR SET II BUOYS: ME



# SUMMARY STATISTICS FOR SET II BUOYS: RMS



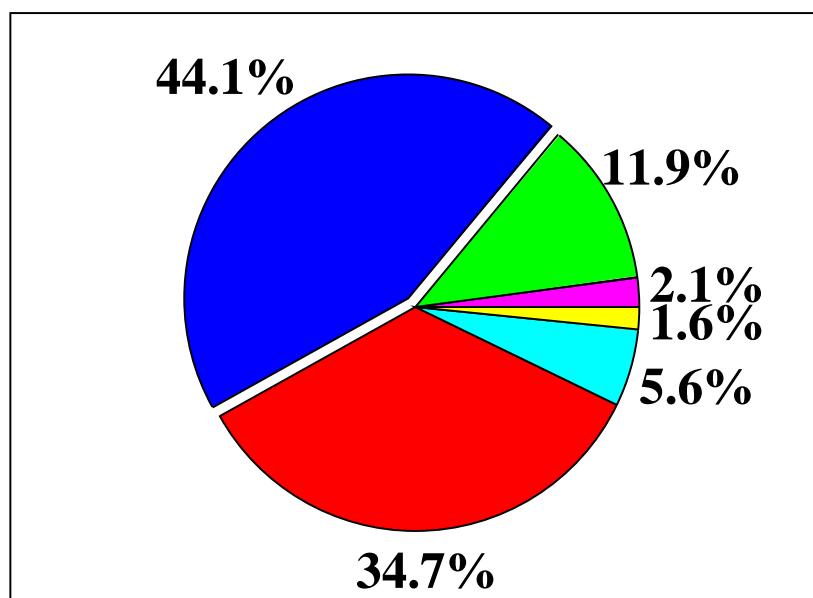
## SST VALIDATION : SET I and SET II BUOYS



- 17,202 daily SSTs from all TAO buoys
- Median SST bias:  $-0.1^{\circ}\text{C}$  for NCOM and HYCOM

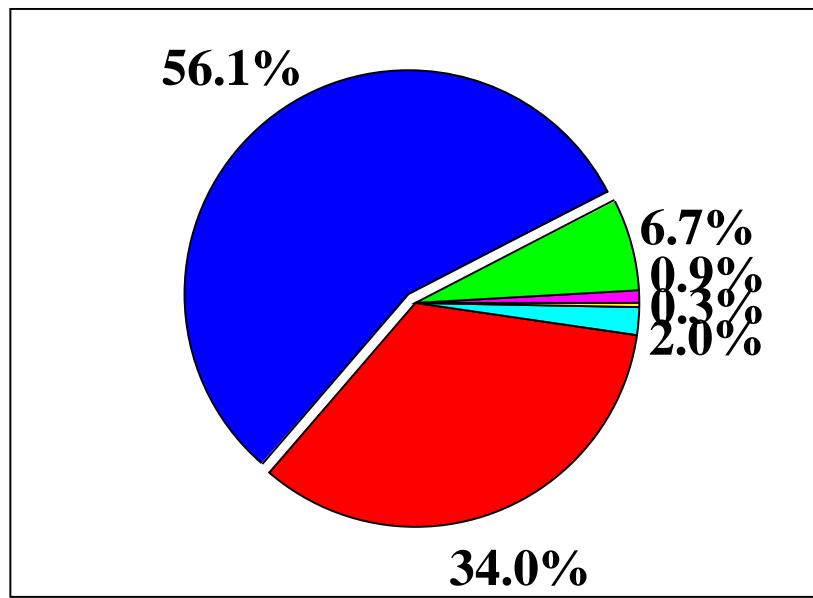
# SST ERROR INTERVALS FOR ALL BUOYS

*SST bias: NCOM vs TAO Buoys*



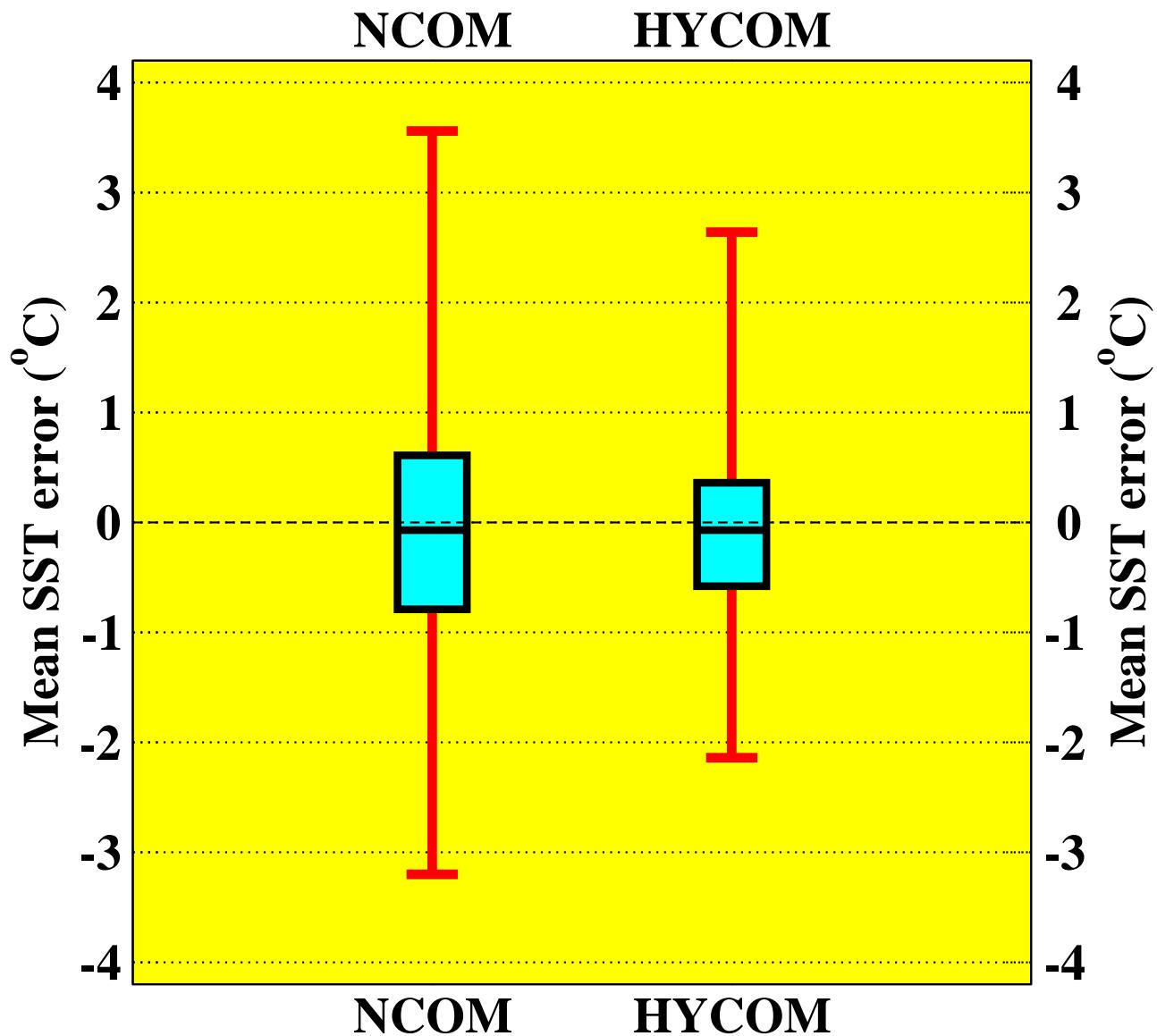
< -1.0°C  
-1.0°C to -0.5°C  
-0.5°C to 0.0°C  
0.0°C to 0.5°C  
0.5°C to 1.0°C  
> 1.0°C

*SST bias: HYCOM vs TAO buoys*



*Results are based on 17,202 daily SST values*

## PERCENTILES OF THE SST ERRORS



- The ends of the whiskers: Min and Max SST biases
- The upper (lower) edge of the box: 95th (5th) percentiles
- The line in the box: Median SST bias
- Note: SST biases from NCOM and HYCOM are NOT skewed.

## **SUMMARY AND CONCLUSIONS**

- HYCOM and NCOM were evaluated in 2004:
  - Subsurface temperatures
  - SST
- Both models yield realistic results